

# BIRD USAGE OF PLANTED TREEBELTS ON FARMLAND AT FRANKLAND, WESTERN AUSTRALIA

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## ABSTRACT

A study of the response of birds to corridors of trees across farmland over a time of 8 years shows how birds have adapted to the new conditions and made use of the trees for shelter, home territories, nests, food source and protection.

## INTRODUCTION

In recent years there has been considerable interest in the fate of native bird communities on lands managed for primary production (Saunders and Ingram 1995; Newby 1999). Most of these studies have been negatively slanted, focussing on the survival of birds in fragmented remnants of native vegetation with very few of the studies having examined the value of revegetation programs to native birds. Farmers in Western Australia have been replanting tree and understorey species on farms in Western Australia for nearly 20 years now. In many of those early plantings the species used were native to Australia, but not necessarily to Western Australia, or a combination of both, as is the case in this study. In more recent times there has been much more emphasis on planting local plant species both to increase the likelihood of establishment and to better provide for the native fauna. The property where

this study was undertaken is called "Payneham Vale", (34°16'S, 117°05'E.), situated in the Frankland district, in the shire of Cranbrook and is owned by Ron and Suzanne Watkins. Ron took over the running of the farm in 1973. At that time, some salt encroachment was becoming evident and he developed a remedial program to deal with it, called an Integrated Whole Farm Plan. His work has gained international recognition (Churchill Scholarship, National Environmental Award and several other awards, the most prestigious being United Nations Global 500 Award). There is ongoing development and refinement of the system, with further drainage and re-forestation having been added, including planting along creek lines and salt areas and introducing *Paulownia*, carobs and olives.

An overview of the farm's activities and a map of the planted and natural timber belts

are presented in Watkins and Watkins (2003).

This study was carried out in an attempt to document:

- (1) The diversity and numbers of birds using the planted treebelts;
- (2) The different ways the trees were used (eg. sources of nectar, seeds, insects and shelter);
- (3) The value of different tree species to birds; and
- (4) Changes in bird species diversity and population numbers over time.

## METHODS

The principles of the Integrated Whole Farm Plan are:

- Survey of the property to ascertain significant landscape features;
- Drains put in along a gradient and dug to clay depth, so that water can be moved into catchment, e.g. dam or creek. The distance between the drains is determined by significant features of the land to control excessive runoff, which causes soil erosion;
- Twelve metre wide tree belts alongside and downslope of the drains provide windbreak, shelter, act as pumps and may provide habitat for birds, native mammals, and other wildlife. The tree belts are situated immediately below the drains, which is the driest part of the paddock, so the plant roots will go deep to take up water from below and

lower the water table; and

- The large catchment of water thus provided is stored in dams to be available for irrigation, aquaculture, etc. or allowed to enter existing waterways if surplus to requirement.

The study began in winter 1989 on the four drains established at that time with their adjacent treebelts. Each treebelt has a length of about 1.6 kms and a width of 12 metres.

Twenty surveys (one per season in each year) were conducted over 5 complete years, 1989/90, 1990/91, 1991/92, 1996 and 1997. Counting was done by walking beside the treebelt recording numbers and species of birds either seen or heard. Birds were recorded as being either in the treebelt, in the paddock or remnant bush adjacent to the drain for a distance of about 75 metres, or flying overhead, and were listed in these separate categories. Treebelts were counted consecutively, in the same order each time and with the four surveys completed on the same day on each occasion. Surveys took about 60 – 75 minutes for each treebelt.

## TREE PLANTINGS

The trees used to establish the treebelts were planted as seedlings, with two rows of *Eucalyptus*, of various species, one row of *Acacia*, and one of tagasaste (*Chamaecytisus palmensis*) (Table 1). All treebelts were fenced to exclude stock.

Table 1. Tree species used at the study site near Frankland, Western Australia. Species marked with an asterisk (\*) are not native to Western Australia, but are native to other parts of Australia. Tagasaste is an exotic species.

Species	Treebelt No.			
	1 (1985)	2 (1986-7)	3 (1987)	4 (1985)
<i>Eucalyptus wandoo</i>	Y	Y	Y	-
<i>E. muelleriana</i> *	Y	-	-	-
<i>E. maculata</i> *	Y	Y	Y	Y
<i>E. camaldulensis</i>	Y	-	-	-
<i>E. globulus</i> *	Y	-	Y	Y
<i>E. resinifera</i> *	Y	-	-	-
<i>E. melliodora</i> *	-	Y	-	-
<i>E. salgina</i> *	-	-	Y	Y
<i>Acacia microbotrya</i> *	Y	Y	Y	-
Tagasaste <i>Chamaecystis palmensis</i>	Y	Y	Y	Y

The plantings in all four of the treebelts established successfully and were, for the most part, quite vigorous in growth. At the commencement of the study the trees in Treebelt 1 were 4.5-6m tall, and had grown to about 12m by 1997. Those in Treebelt 2 had grown from 2.5 - 4.5m tall to about 9m by 1997, those in treebelt 3 from 1.5-3m to 12-14m and those in treebelt 4 from 9m to 12-14m.

The remnant vegetation included in the survey is an area of 8 hectares from where Treebelt 1 starts and another 2 hectare area through which Treebelts 1 and 2 pass. There is a 3 hectare area through which Treebelt 4 passes. Apart from the bush already mentioned, "Payneham Vale" has approximately 25 percent of land left as native bush. The property adjoining on the north side of the study site also has 25 percent uncleared, including a block of 37 hectares. An estimated 15 percent

remnant vegetation remains in a 5 kms radius of the survey area.

There are five dams adjoining the treebelts surveyed. Those on Treebelts 1, 2, and 4 are old established dams of approximately 1 - 2000 cubic metres. The dam on Treebelt 3 is a large dam used for irrigation and is approximately 30,000 cubic metres.

Names of the native birds mentioned in this study follows Christidis and Boles (1994).

## RESULTS

### BIRDS

During the 22 surveys a total of 8063 birds was recorded, representing 77 species (Table 2). Two extra counts (one done in spring 1992 and one in summer 1996) have been included, so this is a list of birds actually recorded in the treebelts during all surveys. For purposes of comparison

Table 2. Number of birds recorded (see text for explanation of abbreviations).

Species Common Name	Trees	Padd	RB	Years					Status	
				Total	89/90	90/91	91/92	96		97
Stubble Quail ( <i>Coturnix pectoralis</i> )	8	4		12	*	*			*	UR
Musk Duck ( <i>Bizirra lobata</i> )	—			1					*	V
Australian Shelduck ( <i>Tadorna tadornoides</i> )	—			138	*	*	*	*		CR
Australian Wood Duck ( <i>Chenonetta jubata</i> )	—			263	*	*	*	*		CR
Pacific Black Duck ( <i>Anas superciliosa</i> )	—			40	*	*	*	*		CR
Grey Teal ( <i>Anas gracilis</i> )	—			45	*		*	*		CR
Hardhead ( <i>Aythya australis</i> )	—			2				*		V
Australasian Grebe ( <i>Tachybaptus novaehollandiae</i> )	—			3		*				V
Little Pied Cormorant ( <i>Phalacrocorax melanoleucos</i> )	—			2		*				V
Pied Cormorant ( <i>Phalacrocorax varius</i> )	—			2	*					V
Little Black Cormorant ( <i>Phalacrocorax sulcirostris</i> )	—			1					*	V
Great Cormorant ( <i>Phalacrocorax carbo</i> )	—			11					*	V
White-faced Heron ( <i>Egretta novaehollandiae</i> )	—			12		*	*	*	*	UR
Black-shouldered Kite ( <i>Elanus axillaris</i> )	3	4		7	*	*	*			V
Brown Goshawk ( <i>Accipiter fasciatus</i> )	1			1				*		V
Wedge-tailed Eagle ( <i>Aquila audax</i> )		3		3	*	*				V
Brown Falcon ( <i>Falco berigora</i> )	1			1						V
Australian Hobby ( <i>Falco longipennis</i> )	2			2					*	V
Peregrine Falcon ( <i>Falco peregrinus</i> )	1			1			*			V
Nankeen Kestrel ( <i>Falco cenchroides</i> )	1			1			*			V
Eurasian Coot ( <i>Fulica atra</i> )	—			1						V

Species Common Name	Years					Status				
	Trees	Padd	RB	Total	89/90		90/91	91/92	96	97
Little Button-Quail ( <i>Turnix velox</i> )	2			2	*					V
Painted Button-Quail ( <i>Turnix varia</i> )	2			2		*				V
Black-fronted Dotterel ( <i>Elseya melanops</i> )	—			8	*			*		UR
Common Bronzewing ( <i>Phaps chalcoptera</i> )	135		4	139	*	*	*	*	*	CR
Crested Pigeon ( <i>Ocyphaps lophotes</i> )	12	9		21	*	*	*	*		UR
Red-tailed Black Cockatoo ( <i>Calyptorhynchus banksii</i> )	13			13		*			*	V
Short-billed Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> )	19			19			*	*		V
Purple-crowned Lorikeet ( <i>Glossopsitta porphyrocephala</i> )	38	3	27	68	*			*	*	CR
Regent Parrot ( <i>Polytelis anthopeplus</i> )	26	4	6	36	*	*	*	*	*	CR
Western Rosella ( <i>Platycercus icterotis</i> )	253	9	14	276	*	*	*	*	*	CR
Australian Ringneck ( <i>Barnardius zonarius</i> )	1016	187	119	1322	*	*	*	*	*	CR
Red-capped Parrot ( <i>Purpureicephalus spurius</i> )	89	8	22	119	*	*	*	*	*	CR
Elegant Parrot ( <i>Neophema elegans</i> )	41	5		46	*	*	*	*	*	CR
Shining Bronze-Cuckoo ( <i>Chrysococcyx lucidus</i> )	4		6	10		*	*		*	S
Laughing Kookaburra ( <i>Dacelo novaeguineae</i> )	21	18	12	51	*	*	*	*	*	CR
Rufous Treeeereeper ( <i>Climacteris rufa</i> )	4	1	19	24	*	*	*			UR
Splendid Fairy-wren ( <i>Malurus splendens</i> )	367		14	381	*	*	*	*	*	CR
Spotted Pardalote ( <i>Pardalotus punctatus</i> )	5		1	6				*		V
Striated Pardalote ( <i>Pardalotus striatus</i> )	19	4	43	66	*	*	*	*	*	CR

Table 2 (cont.)

Species Common Name	Trees	Padd	RB	Total	Years					Status
					89/90	90/91	91/92	96	97	
White-browed Scrub-wren ( <i>Sericornis frontalis</i> )	5			5				*	*	V
Western Gerygone ( <i>Gerygone fusca</i> )	82	9	66	157	*	*	*	*	*	CR
Inland Thornbill ( <i>Acanthiza apicalis</i> )	56		9	65	*	*	*	*	*	CR
Western Thornbill ( <i>Acanthiza inornata</i> )	15		4	19	*	*	*	*	*	UR
Yellow-rumped Thornbill ( <i>Acanthiza chrysorrhoa</i> )	408	16	43	467	*	*	*	*	*	CR
Singing Honeyeater ( <i>Lichenostomus virescens</i> )	242	9	7	258	*	*	*	*	*	CR
Yellow-plumed Honeyeater ( <i>Lichenostomus ornatus</i> )	25			25			*			V
Brown-headed Honeyeater ( <i>Melithreptus brevirostris</i> )	51			51	*	*	*	*	*	CR
White-naped Honeyeater ( <i>Melithreptus lunatus</i> )	150	4	53	207	*	*	*	*	*	CR
Red Wattlebird ( <i>Anthochaera carunculata</i> )	59	27	14	100	*	*	*	*	*	CR
Brown Honeyeater ( <i>Lichmera indistincta</i> )	1202	10	37	1249	*	*	*	*	*	CR
New Holland Honeyeater ( <i>Phylidonyris novaehollandiae</i> )	4	1		5				*	*	V
Western Spinebill ( <i>Acanthorhynchus superciliosus</i> )	2			2	*					V
White-fronted Chat ( <i>Ephthianura albifrons</i> )	4			4	*					V
Western Yellow Robin ( <i>Eopsaltria griseogularis</i> )	4			4				*	*	UR
Scarlet Robin ( <i>Petroica multicolor</i> )	70		7	77	*	*	*	*	*	CR
Red-capped Robin ( <i>Petroica goodenovii</i> )	4			4		*		*		V
White-browed Babbler ( <i>Pomatostomus superciliosus</i> )	6			6		*	*			V
Varied Sittella ( <i>Daphoenositta chrysoptera</i> )	31	10	6	47		*	*			V
Golden Whistler ( <i>Pachycephala pectoralis</i> )	43	2	21	66	*	*	*	*	*	CR



Species Common Name	Trees	Padd	RB	Total	Years					Status
					89/90	90/91	91/92	96	97	
Rufous Whistler ( <i>Pachycephala rufiventris</i> )	12	1	10	23	*	*	*	*	*	UR
Grey Shrike-thrush ( <i>Colluricincla harmonica</i> )	15	1	5	21	*	*	*	*	*	UR
Grey Fantail ( <i>Rhipidura fuliginosa</i> )	123	1	19	143	*	*	*	*	*	CR
Willie Wagtail ( <i>Rhipidura leucophrys</i> )	79	11	5	95	*	*	*	*	*	CR
Magpie-lark ( <i>Grallina cyanoleuca</i> )	15	64	12	91	*	*	*	*	*	CR
Restless Flycatcher ( <i>Myiagra inquieta</i> )	7	2	1	10	*	*	*		*	UR
Australian Magpie ( <i>Gymnorhina tibicen</i> )	58	274	79	411	*	*	*	*	*	CR
Dusky Woodswallow ( <i>Artamus cyanopterus</i> )	6	1		7			*	*		V
Black-faced Cuckoo-shrike ( <i>Coracina novaehollandiae</i> )	2	4	6	12	*	*	*			UR
White-winged Triller ( <i>Lalage sueurii</i> )	1			1				*		S
Australian Raven ( <i>Corvus coronoides</i> )	31	167	39	237	*	*	*	*	*	CR
Welcome Swallow ( <i>Hirundo neoxena</i> )	10	3		13				*	*	UR
Tree Martin ( <i>Petrochelidon nigricans</i> )	113	41	56	210	*	*	*	*	*	CR
Silveryeye ( <i>Zosterops lateralis</i> )	727		13	740	*	*	*	*	*	CR
Rufous Songlark ( <i>Cincloramphus mathewsi</i> )	6	2		8	*				*	S
Brown Songlark ( <i>Cincloramphus cruralis</i> )	11	34		45	*	*	*			S
Richard's Pipit ( <i>Anthus novaeseelandiae</i> )	4	16		20	*	*	*	*	*	CR
Totals Bird Numbers:	5766	969	799	8063						
Species Total:	62	37	34	77						

between treebelts and seasons these extra two surveys were not included in the other data, of four complete seasons/years. The first three columns list the number of birds counted in the treebelt, (Trees), paddock (Padd) and remnant bush (RB); \* shows the years in which birds were recorded. V = vagrant (N<10), U = uncommon (N=10 - 30), C = common (N=> 30), R = resident, S = seasonal. Resident denotes birds known to be resident on this or a neighbouring farm, not necessarily resident in the Treebelt.

## TREEBELTS

The treebelts provided habitat for 5750 birds of 56 species, excluding waterbirds and raptors. Although raptors are recorded in treebelts or paddock, they were flying over those areas and seen so seldom that there are insufficient data to ascertain their use of the treebelts. Tree Martins are also usually recorded flying but are included, because they are seen frequently and are probably resident and foraging for insects that may be there as a result of the extra vegetation provided by the treebelts or remnant bush.

Treebelts provided the following benefits:

- Nectar, seeds and insects, animal, bird and egg prey
- Territories for species such as, Splendid Fairy-wren, Grey Fantail, Willie Wagtail, Scarlet Robin, Inland Thornbill
- Nesting of the territory birds mentioned and probably

others not observed. A Shining Bronze-Cuckoo was observed being fed by Inland Thornbills

- Rest and shelter
- Corridors between remnant bush and revegetated areas.

## PADDOCKS

969 birds of 37 species were counted in the adjoining paddock. These included Richard's Pipit, Brown Songlark, Magpie-lark, Australian Magpie and Australian Raven, which were also recorded in the treebelts and the last three in the remnant bush, but were in bigger numbers in the paddocks. No species was exclusive to the paddock. Most were in the mature eucalypts, which have been left in the paddocks and moving between them and treebelts. The paddocks adjacent to the treebelts contain isolated *E. wandoo*, *E. marginata* and *E. calophylla*. With the eucalypts, acacia and tagasaste in the treebelts, they give a spread of flowering times covering much of the year. The old paddock trees also have useful nesting hollows. Some birds were observed feeding on the ground, such as Australian Ringneck, Western Rosella, Elegant Parrot, Yellow-rumped Thornbill, Scarlet Robin, Willie Wagtail, and Splendid Fairy-wren.

## REMNANT BUSH

799 birds of 34 species were recorded in Remnant Bush. All were also recorded in the treebelts, including Rufous Treecreeper. Also Western Yellow Robin, which was unexpected, as they



had to cross about 10 metres open space to enter the treebelt from the remnant bush. The amount of remnant bush in the area would contribute to the diversity of species, even though much of the understorey is denuded by grazing sheep, cattle and kangaroos. Many birds using the treebelts for foraging and shelter would not find them suitable for nesting, eg. parrots, which would require nest holes in older, larger trees. Being able to move between bush and treebelt is an enormous advantage for most birds and at the junction of the two habitats was often where many birds were recorded. A Yellow-rumped Thornbill nest was observed in *E. wandoo* in the remnant bush of Treebelt 2.

#### DAMS

529 waterbirds of 14 species were

counted either in the dams or in the adjacent paddock. Although not actually using the treebelts they are mentioned as being part of the Whole Farm Plan. Of course, the dams provide drinking and bathing water for the birds that use the treebelts.

#### SEASONAL VARIATIONS

Winter counts were higher in all treebelts except No. 4, due primarily to the flowering of tagasaste, which attracted large numbers of Brown Honeyeater and Silvereye, with smaller numbers of Red Wattlebird, Singing, Brown-headed, White-naped, New Holland, Yellow-plumed Honeyeaters and Western Spinebill. It was particularly obvious in Treebelt 1 where tagasaste was most advanced in the early part of the study.

**Seasonal Variations in Bird Numbers**

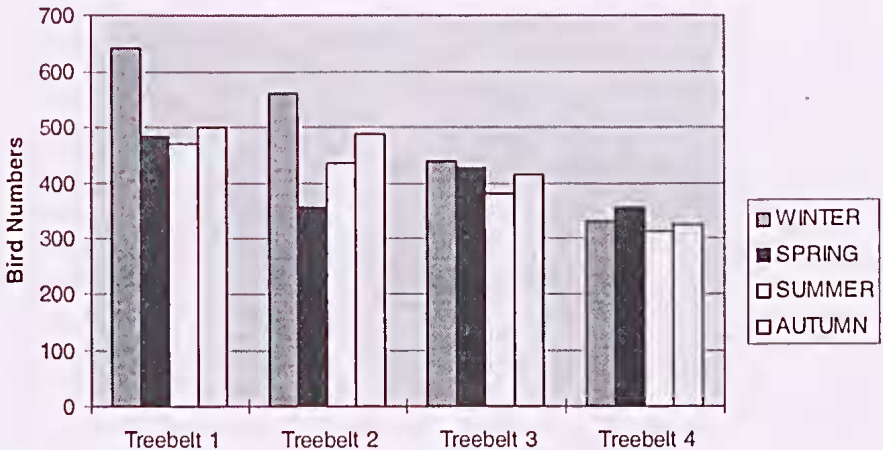


Figure 1. Numbers of birds recorded in each treebelt during each season of the study (data combined for all years).

Honeyeaters and Silvereyes were observed feeding on the nectar provided by flowering eucalypts and tagasaste. The most commonly recorded species was the Brown Honeyeater whose annual total numbers were generally high, beginning at 147 in 1989/90, peaking at 285 in 1996 and returning to 147 in 1997. There was obvious seasonal variation in the numbers of Brown Honeyeaters with large numbers present in winter and early spring when tagasaste is flowering and in very low numbers in autumn. The Silver-eye and other honeyeaters showed a similar trend, although there were a few resident Singing Honeyeater always to be found in the same area of treebelt.

The smaller species of birds appeared to establish most, or all, of their home territories within the treebelts, and a small number were observed to nest there. Juvenile birds of several species (Scarlet Robin, Grey Fantail, and Splendid Fairy-wren) were recorded within the treebelts during the study

Small insectivorous bird species were most abundant in summer and autumn. They colonised the treebelts well, especially Splendid Fairy-wren (n=381) and Grey Fantail (n=143). Yellow-rumped Thornbill (n=467) were always present foraging along the treebelts, but may only have nested in the remnant vegetation where their nests have been observed in *E. wandoo*. The wandoo in the treebelts, being a slow growing species, is still only about 3m tall at the end of the

study. It is particularly prone to insect attack, mainly through the dry months. Inland, Western and Yellow-rumped Thornbills, Western Gerygone, and Striated and Spotted Pardalotes were also observed feeding at flowers, but this may have been in response to insects foraging in the flowers rather than on the nectar sources itself.

Granivorous bird species (parrots, pigeons and quail) were least numerous in the treebelts in spring when most species were breeding in areas supporting mature remnant woodland elsewhere in the landscape. Their numbers steadily increased during summer and autumn, peaking in winter. In the Frankland district sheep are usually hand fed grain during late autumn until well into winter, because of insufficient paddock feed at that time. One of the winter records was of 35 Australian Ringneck feeding on a grain trail laid out for sheep. In spring green stock feed is abundant and supplementary grain feeding unnecessary. In summer the crops are either ripe or harvested, with shed grain on the ground and again there is plenty available for parrots. The Australian Ringneck is the species most recorded, with Western Rosella and Red-capped Parrot well represented. Since the increase of cropping in the region, beginning in mid-1980s, parrot numbers, especially Australian Ringneck, have steadily increased. During the period roughly 1960 to 1990, a large percentage of bush was cleared in the Cranbrook district and much of this is now

Table 3. Total number of nectarivores (Nect.), insectivores (Insect.) and granivores (Gran.) recorded in each tree belt in each season during the study (data combined for all years).

Treebelt	WINTER			SPRING			SUMMER			AUTUMN		
	Nect.	Insect.	Gran.	Nect.	Insect.	Gran.	Nect.	Insect.	Gran.	Nect.	Insect.	Gran.
1	230	92	207	125	90	104	18	164	114	30	152	123
2	197	53	110	130	47	54	32	105	110	50	140	150
3	125	46	130	120	31	56	28	57	106	24	79	92
4	76	58	125	41	58	86	23	64	115	25	68	145
TOTAL	628	249	572	416	226	300	101	390	445	129	439	510

cropped, providing conditions suited to parrots. Red-capped Parrot is also more numerous now than 40 years ago, according to observation and comments of local farmers. Regent Parrots were not seen as far west as "Payneham Vale" until about 1980. Their range ended about 35kms further east. Perhaps this is a local aberration, as Newby (1999) records the status of Red-capped Parrot and Regent Parrot as decreasing in number and/or range.

#### MIGRATORY SPECIES

A small number of species were present for only part of the year. This group comprised the migratory species Rufous Songlark, Brown Songlark, Shining Bronze-Cuckoo and White-winged Triller that enter the southwest of Western Australia during spring and depart in the autumn.

#### CHANGES OVER TIME

When reading Figure 2, it needs to be remembered that the treebelts were planted in different years. Treebelt 1 reached its peak number of birds in 1990/91, which was 5 years after planting. Treebelt 2 was at peak in 1991/92, also 5 years after planting. The peak for Treebelt 3 appears on this graph at 9 years since planting, but may have been earlier. This cannot be ascertained, because of the unavoidable break in surveys between autumn 1992 and autumn 1996. Treebelt 4 only shows that 4 years after planting

## Changes in Birds Numbers in Treebelts

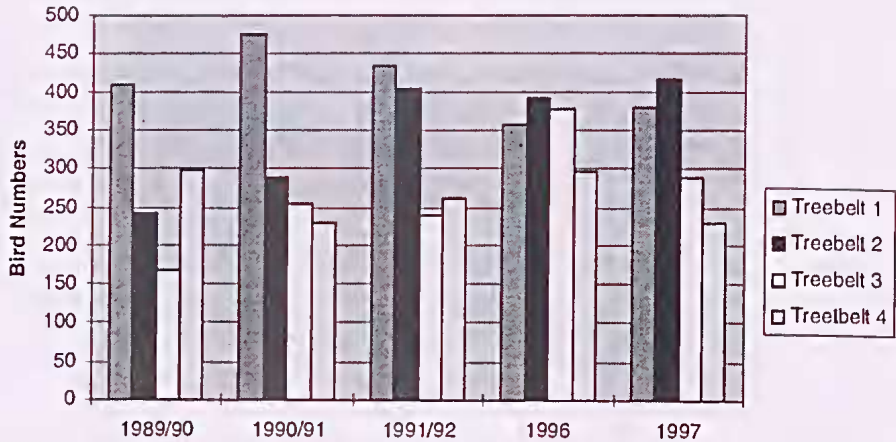


Figure 2. Changes in the total number of birds recorded in each treebelt during the study period, 1989 to 1997.

bird numbers were as high as at any other time of the study.

During the study the number of birds using Treebelt 1 and 4 showed little variation from one year to the next, while the other two treebelts generally supported increasing numbers of birds with increasing age since planting (Figure 2). The small amount of change in Treebelt 1 is attributed to the fact that the trees were already quite mature at the start of the study, with eucalypts estimated at 4.5 - 6 metres tall so were already well colonised and with vigorous tagasaste attracting large numbers of honeyeaters and silvereys when flowering. The thicket of tagasaste seedlings produced also provided good ground cover encouraging small birds. After nine years the tagasaste appears to be losing some of its vigour.

A single White-browed

Scrubwren and two White-browed Babblers attempted to colonise the dense growth of tagasaste seedling in Treebelt 1, the latter moving on after approximately nine months. They were observed being severely harassed by Splendid Fairy-wrens. The White-browed Scrubwren was recorded in Treebelt 1 in autumn and winter 1996, Treebelt 2 in autumn 1997 and summer 1998 and Treebelt 4 in spring 1997. Neither White-browed Scrubwren nor White-browed Babbler is commonly seen in the vicinity. In Treebelt 1 species numbers have increased to 48 bush birds. The increase in numbers appears to have evened out over the last two years, possibly indicating that the population has reached the maximum level that the habitat will sustain.

Treebelt 2 has shown a spectacular growth in bird numbers over the



years, coinciding with the growth of the trees, from 42 in winter 1989 to 159 by winter 1997. Forty-seven species of bush birds and five water birds have been recorded in this belt. Treebelt 3 has shown similar development to treebelt 2, but to a lesser degree. The winter 1989 count was 65, compared to 99 in winter 1997. Again this is attributable to the increased tree growth. The species tally for Treebelt 3 was 46 bush birds and 13 water birds. A large irrigation dam is situated within this Treebelt.

The results for Treebelt 4 are more difficult to analyse. This treebelt produced the lowest figures of all, despite the fact that the trees were more mature, having been planted in 1985. At that time the landowner was still experimenting with optimum species plantings and this treebelt lacks the plant diversity of the treebelts established at later dates. It does not have the row of *A. microbotrya* and is dominated by a row of *E. globulus*, which appears to not be particularly attractive to local birds. Also, this treebelt was routinely the last to be counted, so recordings were often made late in the morning, when birds were becoming less active, especially in hot weather. The tagasaste did not flourish as well as in the other treebelts, possibly because the fast-growing *E. globulus* may have taken too much moisture from the soil. In the last few years the tagasaste improved at this site and developed a thicket of seedlings in the western half particularly, with increased recording of small birds, such as, Inland Thornbill

and Splendid Fairy-wren. Winter and autumn figures were erratic, with the winter 1997 count actually being lower ( $N = 41$ ) than the first count of 51 birds in winter 1989. Spring and summer show little variation over the length of the study. The species count was 47 bush birds and 3 water birds.

Since 1996 no artificial fertiliser, insecticides or herbicides have been used on this farm. Barrett (2000) found that bird diversity is higher where artificial fertiliser is not used.

Table 4 shows how numbers and species increased as the trees matured in all belts. During the eight years since study began the bird numbers have more than doubled. It also gives some indication of what species may be early colonisers and which late.

## DISCUSSION

Except for tagasaste the treebelts were composed of tree species native to Australia, but not native to the southwest of Western Australia, except for *E. wandoo*. They were selected for their quick growing and timber producing properties, so they would establish as quickly as possible and in an attempt to recoup some of the considerable expense of establishment. Endemic trees of *E. wandoo*, *E. marginata* and *E. calophylla* are slower growing, *E. wandoo* is subject to insect attack and *E. marginata* to "dieback" (*Phytophthora cinnamomi*) which made the Eastern States trees seem more suitable at the time. Even so,

Table 4. Changes in bird species composition (excluding waterbirds) recorded in Treebelts between the first survey conducted in winter 1989 and that conducted in winter 1997. Totals indicate the number of birds of each species observed from all four treebelts combined.

	WINTER 1989 Total N	WINTER 1997 Total N
SPECIES		
Common Bronzewing	5	4
Purple-crowned Lorikeet	20	
Regent Parrot	8	
Australian Ringneck	16	51
Splendid Fairy-wren	9	18
Yellow-rumped Thornbill	23	11
Singing Honeyeater	8	22
Brown Honeyeater	36	112
White-fronted Chat	4	
Magpie-lark	7	2
Australian Magpie	11	15
Silvereye	7	97
Western Gerygone	1	12
Scarlet Robin	2	3
Willie Wagtail	1	3
Australian Raven	2	10
Laughing Kookaburra	2	2
Elegant Parrot	10	
Western Rosella	13	12
Stubble Quail		1
Red-capped Parrot		7
Shining Bronze-Cuckoo		2
Inland Thornbill		4
White-naped Honeyeater		10
Golden Whistler		3
Grey Shrike-thrush		2
Grey Fantail		5
Tree Martin		20
Striated Pardalote		1
Rufous Whistler		2
New Holland Honeyeater		2
Red Wattlebird		2
Brown-headed Honeyeater		3
TOTAL NUMBERS	185	440
SPECIES TOTALS	19	29

they provided valuable habitat to support a high number and diversity of birds. The 12 metre treebelts appear to be of sufficient

width for small birds to be able to obtain food for most, if not all of the year, shelter from predators and enough density of foliage to



make safe nesting places. Newby (1999) found that verge width to a low of 10 metres had little effect on the number of species within a site.

The treebelts provided a steady supply of nectar and seeds over most of the year, with autumn and spring flowering eucalypts, *A. microbotrya* flowering from May to October and tagasaste flowering in winter and spring. The seed produced by the *A. microbotrya* is readily eaten by parrots, pigeons and probably quail. Although acacia blossom does not seem to be very attractive to honeyeaters they are visited by many small birds, including honeyeaters, so there must be some other source of food, presumably insects.

Tagasaste produces a large amount of nectar when flowering during winter and early spring and pods in summer, which shed huge amounts of seed onto the ground providing another food source for ground foraging birds. During summer and autumn leaves are shed to about 30%-50% of full cover, with fresh growth commencing again in late autumn. While tagasaste is a valuable source of food for birds, and is quick growing, it is not a native species and has a strong tendency to spread out of control and is especially a nuisance in native vegetation. As a species to encourage birds to the treebelts it is certainly a success. As well as the food aspect, the thick growth of seedlings provide shelter to ground dwelling birds. From the farmers' point of view, it can also be cut and fed to stock during times of feed shortage.

The corridor effect improved the environment for birds to a very large degree, especially the linking of different habitats such as isolated remnants and artificial water storage systems. Many small birds, such as Splendid Fairy-wren, Inland Thornbill and Western Yellow Robin would not normally venture across open paddocks for any distance. In a banding project linked to this study, a juvenile Scarlet Robin mist-netted at the northern end of Treebelt 1 was caught again at the southern end of Treebelt 4, four months later in full adult plumage. Not counted in the surveys, but seen on the farm on other occasions were Collared Sparrowhawk, Buff-banded Rail, Horsfield's Bronze-Cuckoo, Sacred Kingfisher, White-cheeked Honeyeater, and Grey Currawong.

The collection of water from the drainage system into large dams provides habitat for water birds, particularly as the later built large dams have been constructed with this in mind and have at least one shallow bank and some appropriate plantings. The increase in bird numbers observed during this study support the position that these treebelts, in conjunction with the drainage system can be very important to the conservation of birds and the sustainable operation of this farm. In walking across these paddocks 18 years ago, recording birds, the result would probably have been something like: Magpie-lark, Australian Magpie, Australian Raven, Australian Ringneck, and maybe Willie Wagtail, Yellow-rumped Thornbill and Silvereye.

Comparing this to the several hundred birds counted in each survey at the end of the study, emphasises the value of the revegetation work.

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#### REFERENCES

BARRETT, G. 2000. Ecological Management for Agricultural Sustainability. Royal Australasian Ornithologists Union. Supplement to *Wingspan*, vol. 10, no. 4.

CHRISTIDIS, I. and BOLES, W.E.

1994. *The Taxonomy and Species of Birds of Australia and its Territories*. Royal Australasian Ornithologists Union. Monograph 2. RAOU, Melbourne.

MAWSON, P.R. and MASSAM, M.C. 1995. The Birds of a Remnant of Native Vegetation on the Eastern Swan Coastal Plain. *Western Australian Naturalist* 20: 37 – 47.

NEWBY, B. 1999. Birds on farms project in Western Australia. *Western Australian Bird Notes*. Supplement No. 5.

SAUNDERS, D.A. and INGRAM, J.A. 1995. *Birds of Southwestern Australia: an Atlas of Changes in the Distribution and Abundance of Wheatbelt Avifauna*. Surrey Beatty and Sons, Sydney.

WATKINS, R. and WATKINS, S. 2003. "Paynemham Vale": integrated whole farm planning. *Pacific Conservation Biology* 9: 65-67.